Straw tube studies and prototype Assembly

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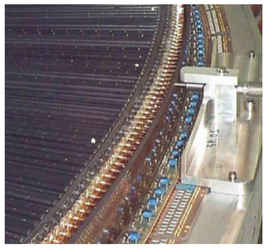
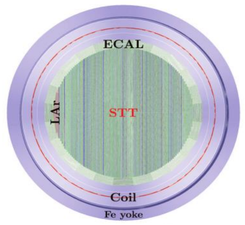
Introduction

Straw tube detector is a gaseous drift detector in which each thin proportional tube (straw) acts as a single channel drift tube. This detector is proposed to being used as a part of one of the configurations of SAND(System for on-Axis Neutrino Detection) in the long baseline neutrino experiment ,DUNE, at Fermilab.



End cap at ATLAS TRT



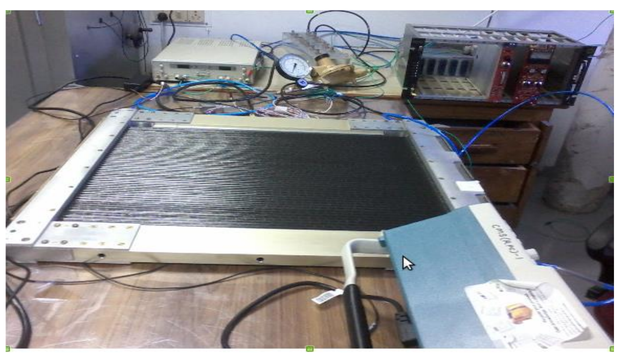
SAND with STT

- Used in ATLAS, NA62, COMPASS
- Low cost detector with excellent particle identification

Our group has an experience of working with gaseous detectors like GEM, RPC. We have 4-channel pneumatic custom-built gas distribution system, humidifier with moisture controller for gases in our department.

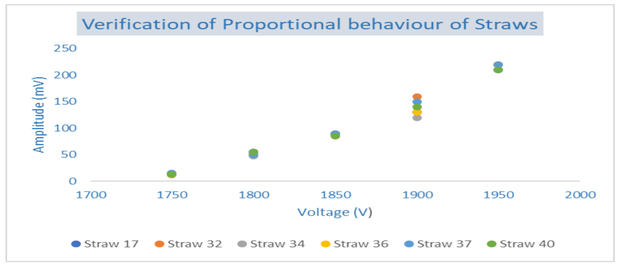
Test Chamber

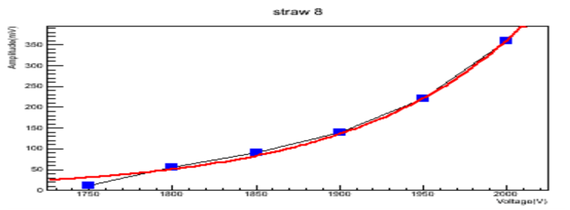
- Prototype we are testing is from JINR, Dubna
- Kapton Straw tubes with 9.3 mm diameter
- 48 Straws in a Single layer
- Signal recorded from all 48 straws
- Na-22 used as source
- Gas mixture: Ar/CO2 (80:20) supplied at 0.3 bar pressure



Prototype with complete setup

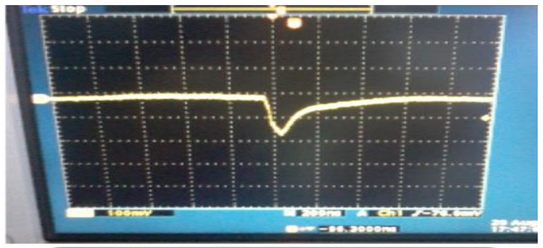
Dual Voltage supply was connected to the pre-amplifier. Input of pre-amplifier is connected to the channels (to be read out) through connectors and output is connected to the CRO. High Voltage supply (1.75 – 2.00 kV) is given to the anode. Whole apparatus was grounded and signal was taken from anode with respect to ground.





V-A curve for random straw tube (Straw 8)

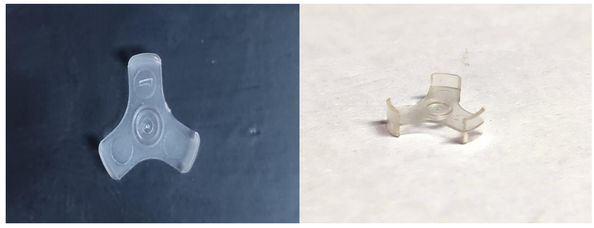
- Black curve represents the experimental values and the red curve is exponentially fitted curve



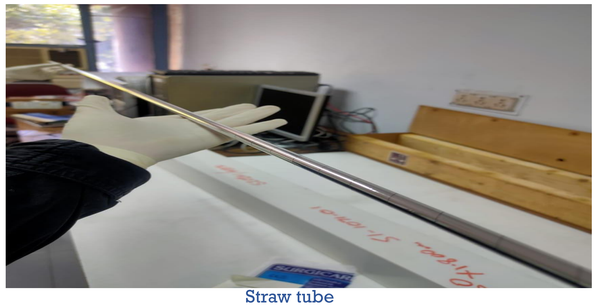
Signal on CRO

ST Assembly and Prototyping

- **Cathode**: Mylar tubes
  Length: 181 cm
  Diameter: 9.5mm
- **Anode**: Gold plated tungsten wire
  Thickness: 20 μm
  Density: 19.22 g/cc



Spacer

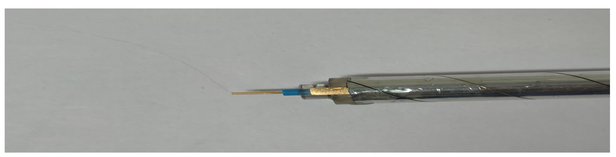


Straw tube

Crimping pin

End cap

- Inserted anode wire in the spacer
- Passed through the tube such that the spacer lies in the middle of the straw tube.
- End-caps were inserted at both ends. Anode wire was passed through the crimping pin.
- Pin was placed inside end-cap (at one end) and crimped. The end-cap was carefully sealed with the help of glue leaving space for the passage of gas.
- Tension of 46 gm was given at the other end and the pin was crimped
- Perspex chamber was also prepared



Straw tube after assembly

Future Plans

- Study V-I characteristics of Single straw with pre-mix gas
- X-ray images for single spacer effects on the wire
- Design a prototype of 1.8m X 50 cm (~50 straws)
- To explore various tooling ways for assembly of single straw tube
- Study with different readout chips
- Test the prototype in Cosmic Ray stand

Cosmic ray stand for testing

Acknowledgements

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- We are thankful to Riya Gaba(post graduate student) for making a 3D modelled prototype diagram for future studies.

References

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- NA62 Technical Design Report https://cds.cern.ch/record/1404985
- LBNF/DUNE Conceptual Design Report, Volume 4
- . LBNE-ND: STT RD AT PU, Vipin Bhatnagar in Neutrino Workshop and Meeting on HEP Instrumentation Center.